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(54) Improvements in or relating to strain gauges

(57) The present invention provides a strain gauge for measuring the elongation of a body and includes first and second members (1,16) arranged for mounting on the body, with an end portion of each member overlapping the other member, the first member (1) having on its end portion an optically coded surface (5) comprising representations of data bits in rows and columns thereon, the second member (16) carrying on its end portion a set of read-out elements comprising, for example, an array (7) of photodetectors extending in a row-wise direction with respect to the rows of the coded surface, guide means (14) for guiding the read-out elements over the coded surface in the column direction. In use, the read-out elements produce a digital signal corresponding to the elongation of the body.

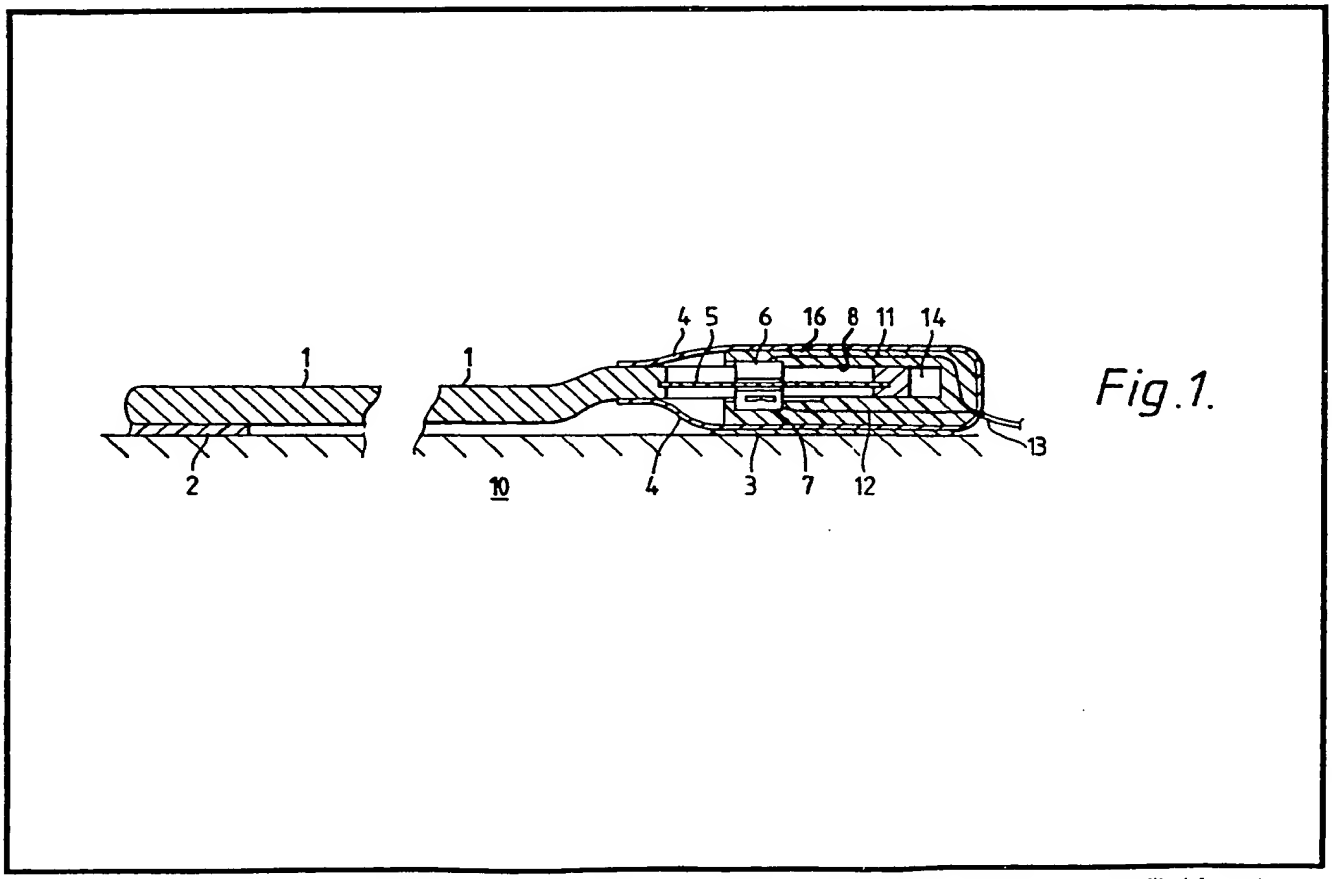

Fig.1.

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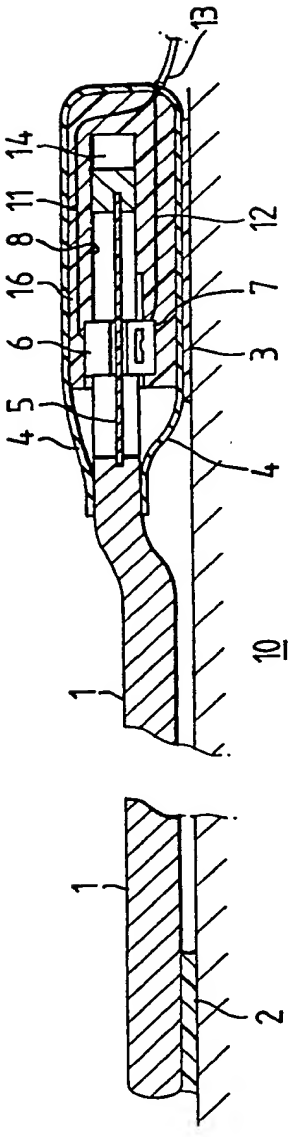


Fig.2.

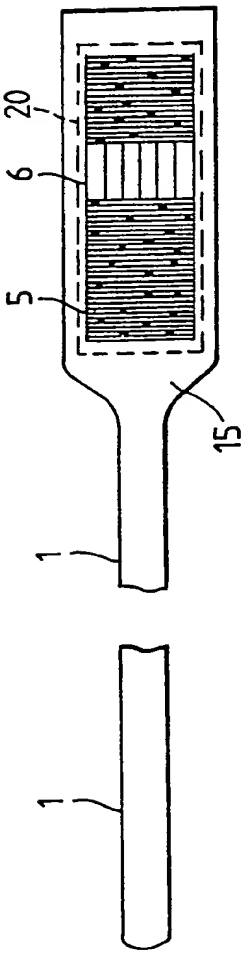
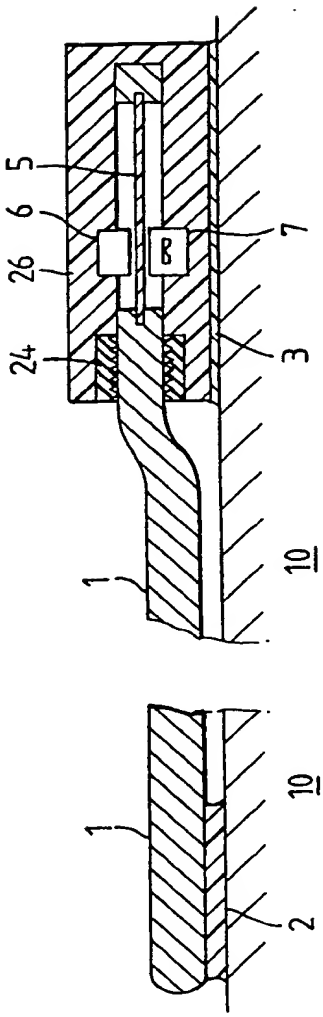


Fig.3.



SPECIFICATION

Improvements in or relating to strain gauges

The invention relates to strain gauges and particularly relates to opto-electric strain gauges.

A known electrical resistance strain gauge includes a resistance wire bonded on an insulator which is bonded on a member the strain of which is to be determined. The electrical resistance of the wire varies with strain and the change of resistance is measured using a Wheatstone bridge circuit. In order to get a digital output indicative of strain from such a circuit on analogue-to-digital converter must be included.

The present invention provides an opto-electric strain gauge which produces a digital output.

According to the present invention a strain gauge for measuring the elongation of a body includes first and second members arranged for mounting on the body with an end portion of each member overlapping the other member, the first member having on its end portion an optically coded surface comprising representations of data bits in rows and columns thereon, the second member carrying on its end portion a set of read-out elements extending in a row-wise direction with respect to the rows of the coded surface, guide means for guiding the read-out elements over the coded surface in the column direction, wherein, in use, the read-out elements produce a digital signal corresponding to the elongation of the body.

In a preferred embodiment the coded surface and the set of read-out elements are contained within an elastomeric envelope. The rigid member may also be wholly or partially included in the envelope.

In a further embodiment the coded surface and the set of read-out elements are housed in a container having a seal in which the rigid member is slideable.

Embodiments of the invention will now be described, by way of example only, with reference to the drawings in which:

Figure 1 is a sectional side elevation of a strain gauge in accordance with the invention and is shown mounted on a surface.

Figure 2 is a plan view of the gauge of Fig. 1 with a housing and seal envelope removed.

Figure 3 is a sectional side elevation of a further strain gauge in accordance with the invention and is also shown mounted on a surface.

The strain gauge shown in Figs. 1 and 2 includes a rigid bar 1 of 'Invar' (Registered Trade Mark) which is secured at its left hand end, as seen in the drawings, to a flat surface 10 by means of nitrocellulose cement 2. The right hand end portion or head 15 of the bar 1, which has an increased transverse dimension compared with the remainder of the bar, has a rectangular aperture 1 with a peripheral groove 16 therein. The head 15 of the bar 1 carries a thin sheet 5 of photographic film having its edges located in the groove 16. The film has an optically coded surface comprising a thousand rows of Gray-coded data bits, each now having sixteen transparent or opaque elements, the row width being one thousandth of an inch. The head 15 is slideably mounted in a slot 8 in a rigid plastics housing 16. The slot 8 has walls 14 which guide the sliding movement of the bar 1 in the direction of the bar's longitudinal axis. The housing 16 is covered by an elastomeric bag 4 which is cemented to the outer surface of the housing 16 and to the head 15 to prevent the ingress of dust and moisture into the housing whilst permitting the head 15 to slide in the slot 8. The bag is secured to the surface 10 by a layer of cement 3.

The housing carries a linear array of light emitting diodes 6 (LEDs) above the film and a linear array of sixteen photodetectors 7 below the film, the arrays being aligned with the optically coded rows and being closely spaced from the surfaces of the film. A twisted pair of wires 11 which are moulded into the housing connect the LED array 6 to a battery. A second twisted pair of wires 12 carry output from the array of photodetectors and are also moulded into the housing. Both pairs of wires extend through the wall of the bag 4 as a cable 13.

In operation when the surface 10 expands on contracts in the direction of the longitudinal axis of the bar 1 the head 15 of the bar slides out of, or into, the housing, and the film 5 which is carried by the head 15 moves relative to the arrays 6, 7 to a new position. The output from the photodetector array 7 is indicative of the new position.

The strain gauge shown in Fig. 3 has a rigid bar 1 and film 5 and associated arrays 6 and 7 and housing 16, similar to the embodiment of Figs. 1 and 2. However, instead of employing a bag for sealing purposes, a convoluted seal assembly 4 which is held under compression between the walls of a recess in the left hand end (as seen in Fig. 3) of the housing 16 and the head 15 of the bar 1 is used. The housing 16 is secured by cement 3 to the surface 10. The operation of the gauge of Fig. 3 is closely similar to that of the previous embodiment.

Modifications and variations to the embodiments described, within the scope of the invention, will be apparent. For example, the film or other member having an optically coded surface could be held in a housing cemented to the surface and the arrays could be mounted on the head of the bar.

CLAIMS

1. A strain gauge for measuring the elongation of a body including first and second members arranged for mounting on the body with an end portion of each member overlapping the other member, the first member having on its end portion an optically coded surface comprising representations of data bits in rows and columns thereon, the second member carrying on its end portion a set of read-out elements extending in a row-wise direction with respect to the rows of the coded surface, guide means for guiding the read-out elements over the coded surface in the column direction, wherein, in use, the read-out elements produce a digital signal corresponding to the elongation of the body.

2. A strain gauge according to claim 1 wherein one of the members is rigid and elongate.

3. A strain gauge according to claim 1 wherein the coded surface and the read-out elements are contained within an elastomeric envelope.

4. A strain gauge according to claim 3 wherein substantially the whole of the first and second members are contained within the envelope.

5. A strain gauge according to claim 1, or claim 2, wherein the coded surface and the read-out elements are housed in a container having a sliding seal in which the rigid elongate member is slideable.

6. A strain gauge substantially as described herein with reference to the drawings.

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